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Case Report

Charcot neuroarthropathy: realignment of diabetic foot by means of osteosynthesis using intramedullary screws – case report☆,☆☆

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ABSTRACT

Diabetes mellitus is a serious disease that affects a large portion of the population. Charcot neuroarthropathy is one of its major complications and can lead to osteoarticular deformities, functional incapacity, ulcers and ankle and foot infections. Realignment of the foot by means of arthrodesis presents a high rate of implant failure due to weight-bearing on an insensitive foot. The aim of this report was to describe successful use of intramedullary osteosynthesis with compression screws to stabilize the deformed foot, in a diabetic patient with neuroarthropathy.

Neuroartropatia de Charcot: realinhamento do pé diabético por meio de osteossíntese com parafusos intramedulares – relato de caso

Palavras-chave:
Articulação de Charcot
Artrodese
Diabetes
Pé plantígrado

RESUMO

O *diabetes mellitus* é uma doença grave que afeta uma grande parcela da população. A neuroartropatia de Charcot é uma das grandes complicações que podem levar a deformidades osteoarticulares, incapacidade funcional, úlceras e infecção no tornozelo e no pé. O realinhamento do pé por meio de artrodeses apresenta elevado índice de falha do implante por causa da descarga de peso em um pé insensível. O objetivo deste relato de caso é descrever o uso bem-sucedido de osteossíntese intramedular com parafusos de compressão para estabilização do pé com deformidade em paciente diabético com neuroartropatia.

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Introduction

There are 285 million diabetics worldwide, representing 6.6% of the population aged 20–79 years. Of these, up to 2.5% develop Charcot neuroarthropathy at some stage of the disease.[1] This complication most frequently involves the midfoot and it results in osteoarticular deformities, significant functional loss, increased risk of ulcers and local infection.[2]

The ideal treatment protocol continues to be a topic of debate in the literature. A recent survey by the American Orthopedic Foot and Ankle Society revealed that treatment of the deformities resulting from Charcot neuroarthropathy is one of the two most controversial problems within the specialty.[3]

Controversy still exists regarding what the best treatment option should be and has given rise to intense debate in papers published within the specialty.[4–8]

With regard to choosing surgical treatment, the major discussion is in relation to the best technique for reestablishing the anatomy of the plantigrade foot and diminishing recurrences of deformities, ulcers and infection. Thus, the type of implant used to stabilize the arthrodesis of the medial and lateral columns of the foot is an important factor.

External fixators show potential disadvantages, with higher rates of superficial infection and non-consolidation.[9]

Dynamic compression plates or plates with angular stability present three disadvantages: greater aggression toward soft tissues, higher osteosynthesis failure rates and higher rates of non-consolidation.[10]

Use of cortical screws in these cases frequently presents the complication of peri-implant fracturing, mainly due to low bone mineral density and the very acute angle of entry into the bone in the midfoot region.[7–10]

Intramedullary screws for stabilizing the medial and lateral columns are a promising alternative for increasing the success rate of this surgical procedure.[2,7,10]

Case report

The patient was 35-year-old woman who had post-gestational diabetes for 20 years and was using insulin. She first came to our clinic two years before the time of the present report, with a history of pain in her left foot, and she now presented a plantar ulcer on the midfoot that had been evolving for four months.

Fig. 1 – (A) Plantar appearance of the foot at the first consultation; (B) plantar appearance of the foot after serial debridement and use of full contact plaster cast.

In the initial examination, she presented pain, edema, hyperemia and temperature elevated by 4 °C in comparison with the contralateral side in the midfoot region, associated with a superficial ulcer of 2 cm in diameter on the plantar face of the midfoot (Fig. 1A and B). Investigation of plantar sensitivity by means of the monofilament test showed the presence of peripheral neuropathy. Vascular examination showed that the pulse was normal. A probe-to-bone test was negative.

The initial radiographic evaluation revealed loss of the usual bone anatomy of the midfoot, with bone fragmentation in the region of the tarsometatarsal joint and alteration of the talus-first metatarsal angles seen in anteroposterior and lateral view, along with plantar bone prominence in the midfoot (Fig. 2A and B).

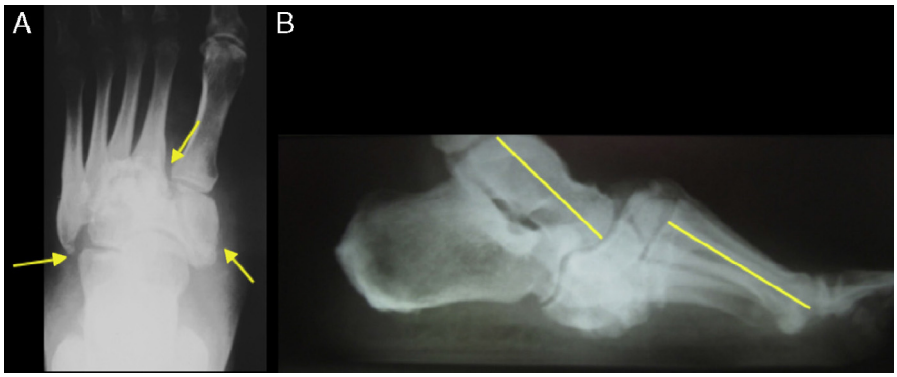

Fig. 2 – Initial radiographic investigation: (A) anteroposterior view of the left foot showing bone fragmentation in the tarsometatarsal region; (B) lateral view showing loss of the medial longitudinal arch of the foot and alteration of the alignment of the talus with the first metatarsal.

Table 1 – Eichenholtz classification.[5,6]

Stage			Clinical characteristics
0	Initial presentation	Pre-fragmentation	Acute inflammatory phase: edematous, erythematous, hot and hyperemic foot
I	Acute Charcot	Fragmentation or development	Periarticular fracture, development of joint subluxation, risk of instability and deformity
II	Subacute Charcot	Coalescence	Reabsorption of bone debris, homeostasis of soft tissues
III	Chronic Charcot	Consolidation or reparation	Bone or fibrous stabilization of deformity repair

Based on these findings, the hypothesis raised consisted of diabetic foot syndrome in association with Charcot neuroarthropathy of stage II of the Eichenholtz classification system (Table 1) and cutaneous ulcer of type II of the PEDIS classification system (perfusion; extent; depth; infection; and sensation) (Table 2).

The initial treatment consisted of serial debridement of the devitalized tissues on the border of the cutaneous lesion every seven days and protection against loading by means of a full-contact plaster cast, until the cutaneous lesion had closed, which took six weeks (Fig. 1B).

During the second phase of the treatment, foot realignment was planned, with restitution of the bone relationships by means of extended triple arthrodesis and osteosynthesis using intramedullary cannulated screws.

The surgery was performed with the patient in horizontal dorsal decubitus. The anesthetic method used was spinal anesthesia combined with sedation.

A pneumatic tourniquet at 300 mmHg was used on the left lower limb after draining the veins by means of an Esmarch bandage.

An extended suprafibular lateral access and a medial access were used. The lateral access was used to perform dissection of the subcutaneous layer and deinsertion of the musculature of the short extensor muscles, in order to gain access to, perform decortication on and realign the lateral surfaces of the subtalar, calcaneocuboid and tarsometatarsal joints. The medial access was used to approach the talonavicular, navicular-medial cuneiform and medial cuneiform-first metatarsal joints. After achieving realignment and provisional stabilization using Kirschner wires, the position was checked by means of radioscopic control (Fig. 3A and B).

The definitive osteosynthesis of the subtalar joint was performed using an Accutrak® Plus screw; the calcaneocuboid-fourth metatarsal joint using an Accutrak® 6/7 screw; and the talonavicular-medial cuneiform-first metatarsal joint using an Accutrak® 6/7 screw.

After fixation, we performed percutaneous tenotomy on the short extensor tendons of the second to fifth toes.

The patient was kept without weight-bearing for 30 days after the operation. After this date, she began to progressively apply weight, using a brace from the sural area to the foot, and she started physiotherapy for gait training.

Ninety days after the surgery, she started to apply her full weight, while still using a brace, which she continued to use until completing 120 days after the operation.

Twelve months after the operation, the patient was free from complaints, could walk without the aid of crutches, had a well-defined medial longitudinal arch and presented preserved hindfoot and forefoot alignment (Fig. 4A–C).

Control radiographs produced 12 months after the operation showed a talus-first metatarsal angle of 6° and dorsal displacement of 3 mm (Fig. 5A–C).

Table 2 – PEDIS classification.

Grade	Lesion characteristics
I – No infection	Wound without purulent secretion, without signs of inflammation
II – Mild infection	Lesion involving only the skin or subcutaneous layer, with the presence of more than two signs: local heat, erythema >0.4–2 cm around the ulcer, local pain, local edema, drainage of pus
III – Moderate infection	Erythema >2 cm, with one of the signs cited or involving infection of structures deeper than the skin and subcutaneous layers (fasciitis, deep abscess, osteomyelitis or arthritis)
IV – Severe infection	Any infection of the foot in the presence of SIRS (two of the following conditions: temperature >38 °C or <36 °C, heart rate >90 bpm, respiratory rate >20/min, $PaCO_2$ <32 mmHg, leukocytes >12,000 or <4000/mm^3 and immature forms 10%)

Source: Directrices panamericanas para el tratamiento de infecciones en úlceras neuropáticas de las extremidades inferiores. Rev Panam Infectol. 2011;13(1 Suppl. 1):S4.

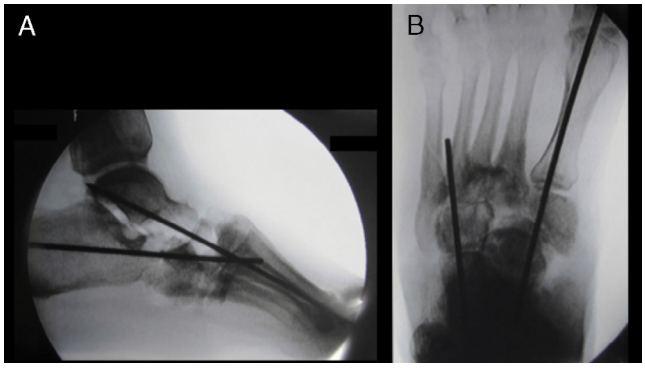

Fig. 3 – Intraoperative control radioscopy to check the provisional stabilization: (A) lateral view showing reestablishment of the alignment of the talus with the first metatarsal and absence of plantar bone salience; (B) anteroposterior view showing adequate alignment of the talus with the first metatarsal, and of the cuboid with the fourth metatarsal.

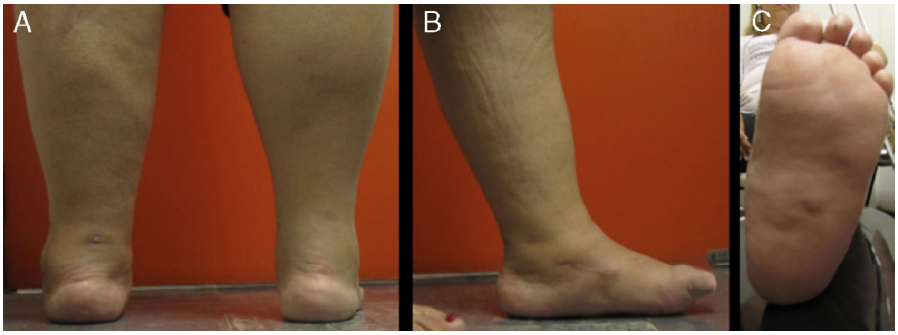

Fig. 4 – Clinical photos of the patient showing the foot alignment 12 months after the operation: (A) posterior image of the foot showing the hindfoot realignment achieved; (B) medial image of the foot showing the realignment between the hindfoot and midfoot; (C) image of the plantar region of the foot showing the achievement of a plantigrade foot.

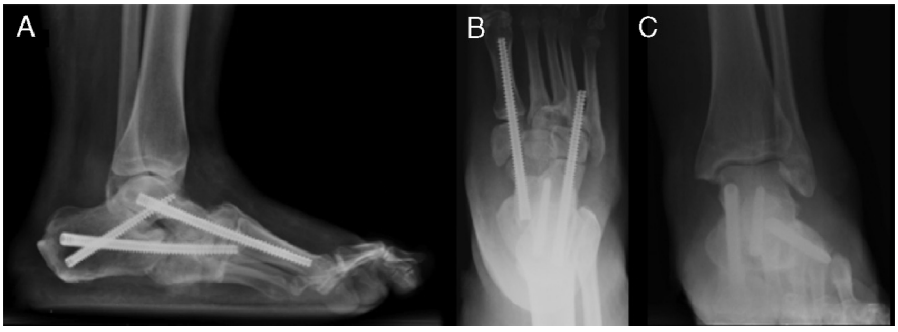

Fig. 5 – Radiographic control 12 months after the operation: (A) lateral view of the foot showing evidence of correction of the alignment of the axis of the talus with the first metatarsal; (B) anteroposterior view of the foot showing maintenance of the alignment of the screws and the alignment of the axis of the talus with the first metatarsal; (C) anteroposterior view of the ankle showing maintenance of the tibiotalar joint.

Discussion

The clinical and radiographic results were satisfactory after 12 months of follow-up.

Surgical reconstruction of the midfoot collapse has the aim of reestablishing a plantigrade foot without plantar bone prominences, so that the plantar pressure will be better distributed and ulcers, infection and amputation will be prevented.

Restoration of the alignment of the medial and lateral columns of the foot using intramedullary screws to treat Charcot neuropathy in the midfoot has been described in published case series.[2,3,7–9]

This option for osteosynthesis has biomechanical advantages, since it has the objectives of increasing the consolidation rate, diminishing the dehiscence/infection rates and avoiding failure of the implant material.

Patients with diabetic neuropathy have difficulties in balancing and in controlling their weight placement on the lower limbs. Thus, intramedullary implants present biomechanical advantages in relation to extramedullary implants.[1]

Some authors have advocated using massive screws in this surgical technique. However, the screw implant used in the present case report was cannulated.

There are still no *in vivo* comparative studies on the different implants available.

We conclude that use of cannulated screws without heads is a viable procedure for intramedullary fixation of foot realignment in treating Charcot neuroarthropathy.

Study designs with higher-grade evidence are needed in order to define treatment protocols with appropriate recommendation levels.

Conflicts of interest

The authors declare no conflicts of interest.

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